3.3.5 *Description of the plant*

The plant is designed with a production capacity of 50 kt/a, based on 8,000 working hours per year. The process, based on single-stage technology, provides for two lines of parallel reactions identical from the point of view of the equipments used.

In figure 3.7 is illustrated a simplified flow diagram of the process, the continuous lines stand for the flowing liquids, and the broken lines for the gaseous discharges .

The principle sections are:

- reaction section: includes the reactor, the condensation system, the feeding system for the raw material before the recycling of the gas around the reactor.

- flash to low pressure section: it separates the dissolved gases (CO and CO_2) from the liquid phase containing the organic products;

- acid distillation section: essentially made of an acid distillation column, from the bottom of which one recovers the hydrochloric acid (that is left in the reaction section); from the top of the column the DMC/methanol/H2O mixture for purification is sent to the next section for azeotropic distillation directly to the vapour phase;

- azeotropic distillation section: the mixture originating from the acid distillation section is sent to the azeotropic distillation column after which one must separate DMC/ Methanol (that was recycled in the reaction system) from the top of the azeotropic column, the product from the bottom of the column comprises of an aqueous DMC solution containing about 400 ppm of methanol;

- DMC/ water distillation section: the product at the bottom of the azeotropic distillation column (preceding section) is unmixed for separation; after cooling the two phases- one aqueous and the other organic rich in DMC, the organic phase and the aqueous phase are purified (by distillation) in special packed columns, so that the obtained DMC is available for stocking and the obtained processed water for water treatment system of the plant (TAS).

The remaining parts of the plant are the cold wash & gas separation sections

- Cold wash section: in this section the non-reacting gases & those that come from the flash section are subjected to scavenging with cold methanol to reduce the methyl chloride content to within 1 ppm; the flowing methanol, after stripping, is sent back to the feed tank of reactors to recover the DMC contents, while the stripped gas together with the other chlorinated purgings is sent to the chlorination disposal, run by the Environment Society (Societa Ambiante); the "cleaned" gases (rich in CO & CO_2) are sent to the gas separation section.

- gas separation section: for the recovery of CO, the flowing CO/CO_2 coming from the cold wash section is subjected to a MDEA process of BASF Aktiengesellschatt-Marketing intermediates, by which one recovers more than 90% of the non-reacting CO that is recycled in the reaction.

50 kt/a DMC Plant at Ravenna

Simplified Flow Diagram

Gas to CTE (CO + CO2 + inerts) [Gas a CTE (CO + CO2 + inerti)]

Co2 to the CO production plant at Rivoira [Co2 ad impianto produz. CO Rivoira]

sep. CO/CO2 section [Sezione Sep. CO/CO2]

Cold Wash Section [Sezione Cold Wash]

Purging of chlorinated organic by-products into the Ambiente SpA incinerator [Spurgo sottoprodotti organici clorurati a forna inceneritore Ambiente SpA]

Pulmonisation continues to FIS Ambiente SpA [Pulmonazioni continue a FIS Ambiente SpA]

Recycled Co [CO di riciclo]

CO Compression Section [Sezione Compressione Co]

Purging gas reaction section [Spurgo gas sez.reaz.]

Purging gas flash section [Spurgo gas sez flash]

[Stocking of DMC ISOLA 20]

Oxygen Compression Section [Sezione Compressione Ossigeno]

Reaction Section [Sezione Reazione]

Flash Section [Sezione Flash]

Acid Distillation Section [Sezione Dist. Acida]

Azeotropic distillation Section [Sezione Dist. Azeotropo]

DMC/water distillation Section [Sezione Distillazione DMC/acqua]

Recycled HCl [HCl di riciclo]

Stocking of methanol [Stocaggio metanolo]

Recycled azeotropic DMC/Methanol [Azeotrpo di riciclo (DMC/Metanolo]

Organic effluents for Stability treatment (TAS) [Acque organiche a trattamento di stabilimento (TAS)]

Stocking of HCl

3.3.6 *The process*

The process is based on the oxidative carbonisation of methanol with carbon monoxide and oxygen, and the use of copper chloride as catalyst with one step technology.

The reaction system is triphasic, gas-liquid-solid, and the reaction is continued uninterruptedly, the reaction products remain in vapour phase with the non-reacting gas ("One Step Technology").

The operating conditions are the following-

Temperature:	132.8 C
Pressure:	23.5 Bar g
Catalyst concentration (as CuCl):	160 kg/m3

The following reactions occur in the reactor:

a) $2\,CH_3OH + CO + \frac{1}{2}\,O_2 \rightarrow CH_3O\text{-}CO\text{-}OCH_3$ [2] $+ H_2O$

b) $2\,CH_3OH \rightarrow CH_3\text{-}O\text{-}CH_3$ [3] $+ H_2O$

c) $3\,CH_3OH + \frac{1}{2}\,O_2 \rightarrow CH_3O\text{-}CH_2\text{-}OCH_3$ [4] $+ 2\,H_2O$

d) $CH_3OH + HCl \rightarrow CH_3Cl$ [5] $+ H_2O$

e) $CO + \frac{1}{2}\,O_2 \rightarrow CO_2$

The primary reaction is the reaction a), in fact 94% of the methanol and 55% of the converted oxygen are used up in this reaction.

The second in order of importance is e) that involves 44% of the converted oxygen.

DMC = Dimethylcarbonate
DME = Dimethyl ether
Methylal
MeCl = Methyl Chloride

The passage conversions are, for methanol and for oxygen, 24% and 99% respectively.
The heat produced from the reaction (about 140 kcal/mole reacted oxygen) proves to be sufficient for the evaporation of all organic products.
The reaction products and the non-reacting gases leave the reactor, depending on the relative liquid-vapour equilibrium, restoring the saturated gas to the working conditions. The concentration of oxygen at the exit of the reactors is between 0.3-0.4 % v and is continuously monitored across two oxygen analysers on each reaction line, while the probable content of hydrochloric acid is about 250 ppm.

The hydrochloric acid is used in the plant for the purpose of restoring the lost chlorine of the catalytic system, during the normal operation (mainly the formation of methyl chloride), or to carry out the scavenging of the reactors, so as to dissolve the encrustation of catalysts from the walls of the equipments before inspection. The scavenged hydrochloric acid is used in solution of about 30 % by weight in the completely packed reaction section during the working of the plant, along with that recovered by acid distillation.

The mentioned overflow and the recycled discharge, either liquid or gaseous, are converted in the reaction section that operates at about 130 degrees C with a working pressure of 24 atm.

The flowing liquid obtained from the steam condenser after discharge from the reactor (containing hydrochloric acid, DMC and other organic products) is sent from the flash pressure section to low pressure(about 0.2 atm) section, from where one can extract the dissolved gases from the same flow consisting primarily of CO and CO_2.

After purification from the dissolved gases, the flowing liquid is partially evaporated and enters into the acid distillation section in which, through a distillation column with structured support, one separates at the bottom an aqueous solution of hydrochloric acid (8-10%) that is recycled in the reaction section and on the top an organic mixture of methanol/hydrochloric acid/water. To guarantee the separation of hydrochloric acid and the organic components, if the processed water already present in the mixture supplied to the column is not sufficient, the addition of demineralised water may possibly be required.

The organic mix obtained from the top of the acid distillation column is supplied in vapour phase, permitting an optimisation of vapour consumption based on known technology, to a distillation column in the azeotropic distillation section in which one obtains the separation of an aqueous

solution of DMC at the bottom and azeotropic methanol/DMC on the top and then sent for recycling in the reaction section.

In the subsequent section of DMC/water distillation the flowing liquid coming from the azeotropic distillation is unmixed after cooling in the separator in which one obtains a heavy organic phase (containing mainly DMC) and a light aqueous phase (containing mainly water). The organic phase is fed to the DMC distillation column from which one obtains the product intended for sale and/or subsequent use, the aqueous phase is sent to the water distillation column in which one removes the organic products (mainly DMC) or to release the pollutant load to the TAS to which one directs the water to recover the DMC content in the aqueous phase.

The gaseous discharges , coming mainly from the reaction and flash sections are rich in CO and CO_2 and contain a number of impurities, and hence are subjected to a cold wash at –25 degrees C (cold wash section) with methanol, by which some gaseous effluents containing less than 1 ppm of chlorinated compounds are obtained.

In this section the cooled gas after the treatment enters the absorption column packing where it should be scavenged with cold methanol at the top of the column. From the top of the column one obtains a gaseous discharge containing primarily carbon dioxide and carbon monoxide that is sent to the CO/CO_2 separation section.

The scavenged methanol, from the bottom of the absorption column, passes to the stripping column, to regenerate the methanol by recovering from the absorbed impurities. In the same column one separates from the top a mixture containing 90 % of methylal fed to the section, complete dimethylal, the methyl chloride and a residual part of the dissolved gas; this mixture is condensed and the gases that separate are sent to the treatment system for chlorinated effleunts, while the liquid is recycled with reflux.

At the bottom one obtains the regenerated methanol, that after cooling, is returned to the absorption column.

In the separation section CO/CO_2 is scavenged with amine, from this wash (and consequent recovery of the amine by stripping of the CO_2 absorbed in it) it is possible to obtain two gaseous discharges : CO discharged for recycling in the reaction section, and CO_2 that is discharged in part to CTE (together with the purging discharges of the inerts containing Co) out of the stacking limits and in part to the Rivoira Society for the recovery of carbon content.

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...reaction section, the organics are separated. The condensates of the compression stage are collected in the pressure tank V-511 and emptied into the level control of column C 502. The gases obtained from V-511 are fed to tank V-802 under controlled pressure and are sent from there, through the storage tank, to the chlorine-containing waste treatment tank.

During shut-downs for maintenance operations or equipment inspection, the reaction slurry in the flash tank is transferred from one equipment to the other, (This is performed at a pressure difference by pressurising under nitrogen, a fixed line of dedicated connection is provided. The pulmonisation vent is fed to the C-302 column.)

Acid Distillation Section:

(Ref. to process diagram D-06003)

The liquid product obtained from the flash tank V-501 A and V-501 B is fed at controlled rate to the evaporator E-621 where 80% of the flow is evaporated in a single throughput. The duty required for the operation is fed through low-pressure steam (LLS).

(The vapour flow rate is regulated in cascade with the feed rate to the evaporator.) The boiler E-601 is fed with low-pressure steam (LLS) at controlled rate from the bottom level of column C-601 . This controls the heat around the acid distillation column.

The vapour and liquid phases leaving E-621, enter the packed distillation column C-601, from the bottom of which hydrochloric acid is recovered completely as an aqueous solution of about 8–10% and the copper is entrained from the reaction section. Methanol, DMC and acid-free water from the top of the column is fed in vapour phase to the azeotropic distillation column C-602.

After the removal of the acid from, i column C-601 a stream of demineralised water obtained from the collection tank V-701 and cooled in E-702 is fed into E621 at a controlled rate. On the other hand the r flux is made up of a part of methanol/DMC azeotrope coming from the azeotropic distillation column C-602 and cooled in E 611. From the bottom of the column C 601 the acid solution is split into two streams, one is fed at controlled feed rate to the pumps P 302 A/B and P 402 A/B after it had been cooled in E611.

Azeotropic Distillation Section:

(Ref. to process diagram D-06003)

The vapour phase stream coming from column C-601 is fed directly to the azeotropic distillation column C-602.

The required duty is fed through the boiler at the bottom of E-602. The methanol/DMC azeotrope (70/28% W) obtained from the top of the column is condensed in the condenser EC-612 A/B and collected in the tank V-612. From here part of the azeotrope is fed under reflux at controlled feed rate, to the azeotropic distillation column through pump P 612 A/B. and the remaining is fed, at level control of tank V-612,(to the organics feed tank to the reactors V-202.)

The lighter vapours separated in the reflux accumulation tank are fed to the condenser EC-622 to reduce the loss of methanol and DMC, and the remaining stream, consisting primarily of dimethylal, methyl chloride, methylal and CO_2, is fed to the pulmonisation collection tank V-802, and from these storage tanks to the incineration treatment of the chlorine-containing refluxes.

The product at the bottom of the column, a DMC/water azeotrope, with a methanol concentration of approximately 400 ppm, is fed through the pump P-602 A/B to the final section of distillation before cooling of the mixture in E-652.

DMC/Water Separation:

(Ref. to process diagram D-06004)

The product at the bottom of the azeotropic column is separated into two phases, one aqueous (light) and one organic-rich in DMC (heavy), in the phase separator V-602.

The organic phase is fed to the packed column C-603, through pump P-613 A/B at controlled feed rate by readjusting to the interface level of V-602. (The required duty is through the boiler bottom E-603.) The DMC is recovered at the top and discharged, at level control, through the pump P-603 A/B to the stocking tank farm before cooling in E-653. A part of the product can also be fed for in-house use in the factory and for the existing plants at blocks 19 and 5. Any product which deviates from the specifications can be directed to a dedicated tank and be packed in the plant at the appropriate position.

The product at the top containing DMC and the entire water fed to C-603 (azeotropic mixture) is condensed along with the vapours at the top of column C-604 in the condenser EC-613 and recycled to the separator V-602.

The aqueous phase obtained from V-602 is fed at controlled feed rate to the packed column C-604 through the pump P-614 A/B, while a part of this stream is recycled to the column C-602 to avoid accumulation of methanol in the section as it may hamper the separation of phases.

The duty to column C 604 is fed through the boiler E-604.

The mixture of organic compounds at the top of the column is removed along with some water and recycled in the separator V- 602, while the water at the bottom is cooled in E-654 and fed at level control through the pump P -04 A/B for the water treatment in the storage tank.

Gas treatment section (Cold Wash):

(Ref to process diagram C-06005)

The purged gases from the reaction and flash section contain a series of impurities dissolved in CO that need to be removed before the gas is fed to the recovery section and recycled in the plant. The streams obtained from the condensers EC-321, EC-421 and from VK-501 D are collected and fed to EC-541, where they get cooled by means of the gas that leaves the section. At the entry of the exchanger a small stream of methanol is injected to avoid formation of frozen solids that could obstruct the throughput stream.

A stream of ammonia, coming from ME-502 unit, cools the gas entering EC-551, by evaporating to reach –25 degrees C t. The cold gas enters the packed column C-501, operating at 20.5 bar g, where it is scavenged with cold methanol fed from the top of the column.

The scavenging is done until the amount of methyl chloride in the exit gas at the top of the column falls below 1 ppm. The scavenged gas passes through the exchanger EC-541 to cool the purged gases and proceeds towards the CO/CO_2 separation section. This final scavenging with MDEA guarantees a recovery of non-reacting CO that can be recycled separately in the reaction sections, after it is combined with (make-up) CO in the compressor KA-301 (KA-401).

From the bottom of column C-501, the spent methanol is fed at level control to the exchanger EC-521 where it cools the scavenged methanol and from there to E-552 to supply the acked regeneration column C-502. The stream coming from the tank V-511 can be fed to the column.

The duty is fed through the boiler E-502. The product at the top containing 90%of methylal fed to the section, dimethylal, the methyl chloride and the

dissolved gas s, is condensed in E-512 and collected in tank V-512. The liquid is recycled under reflux to the column C-502, while th gases that separate are discharged under controlled pressure into the tank V-802 to be fed through the storage tank to the incinerator for the treatment of chlorine-containing wastes.

From the bottom of the column the regenerated methanol containing DMC is drawn by means of the pump P-502 A/B and fed to E-552 where it supplies heat to the stream feeder C-502. A part of the stream is fed from the level control of the column C-502 to the organic feeding tank of reactor V-202; while another is fed at controlled feed rate to the exchanger EC-521 and subsequently to EC-531 where it is cooled by the ammonia coming from the ME 502 unit. The methanol that is cooled is fed to the column C-501.

CO/CO_2 s paration:

(Ref. to diagram C-06007)

In the CO recovery section, the recycled gas, coming from the exchanger EC-541, is subjected to scavenging with a solution of activated MDEA, of about 50% concentration by weight, for the purpose of separating the CO_2 content in the recycled gas.

The absorption takes place in column C-581 in which the recycled gas enters from the bottom and comes in contact with a countercurrent of regenerated MDEA stream.

The recovered condensate coming from PA-711 A is injected at the top of the column C-581 to reduce entrainment.

The purified gas stream is sent from the top of the column to the final compression stage KA-301/ KA-401. The excess inerts are purged in V-801 under controlled pressure.

A stream of regenerated 10% MDEA solution is filtered under controlled throughput in the vertical active carbon filter MS-582 before being sent to column C-581. The function of the filter is to retain the degradation products of the MDEA solution and the metal and oxide particles of dimension less than 3 microns.

The spent MDEA solution leaves the bottom of column C-581and is sent, under pressure difference and at the level control, to the top of the flash column C-583 for initial regeneration to be completed in column C-582.

The overhead vapours of C-582 enter from the bottom of C-583.

The stripping vapour from the two columns is supplied to the boiler of the regeneration column MDEA E-582.

Some of the CO_2 absorbed in column C-581 is released at the top of column C-583. It meets the wet CO_2 stripped in column C-582 and is then fed to the base of C-583.

The wet CO_2 is sent to the condenser EC-581 where the vapour is condensed to a large extent. V-581 functions as a reflux accumulator and is equipped with three plates for scavenging CO2 separately with water fed in controlled throughput through the pump P-585 A/B (B reserve).

The reflux at the column C-583 is sent in controlled throughput and adjusted to the level of the separator V-581.

The pressure in columns C-582 and C-583 in the separator V-581 is maintained through a system so that it is possible to send some portion of the CO_2 to the stacking limit for recovery in the production unit of CO and the rest to the separator V-801 for disposal.

The solution of semi-rich MDEA accumulated at the bottom of the column C-583 is sent to the top of the column C-582, to complete the regeneration, through the pump P-582 A/B: The removal takes place at controlled throughput and regulated with the level control placed at the bottom of C-583.

Before sending to C-582, the semi-rich MDEA is reheated in the exchanger E-581 A/B/C (in series) at the expense of the regenerated MDEA coming from the boiler E-582.

The regenerated MDEA is partially cooled and sent to the absorption column C-581 through the pump P-581 A/B (B reserve), before cooling in the cooler E-583

(water). The temperature at exit is controlled through a regulator that functions as a three-way valve installed at the top of E-583 and permits partial by-pass from the exchanger.

Then the regenerated MDEA is sent to column C-581 under controlled throughput with the regulation signal coming from level control of boiler E-582.

The drainage tank MDEA V-584 collects the drained MDEA solution. A throw-out pump P-583 A (B to the storehouse) is installed in the drainage tank.

The tank is installed in a basin below ground level.

The tank also serves for the preparation of fresh MDEA solution.

The storage tank MDEA V-583 is positioned horizontally and is nitrogen purged; in case of plant shut down the MDEA solution is first discharged in V-584 and from it is pumped in V-583. The purging of V-583 is extended to the V-584 tank.

The storage tank MDEA V-583 is connected to tank V-584 underground. It is thus possible to transfer the solution from V-583 and V-584 underground and from it to transfer to the pump suction P-585 A/B or P-581 A/B through the pump P-583 A, and the throughput can be measured with a local indicator.

A connection is provided on the delivery side of the pump P-583 A. for the spent MDEA to be removed and loaded in a tank truck.

The injection pack of the corrosion inhibitor ME-581 consists of the corrosion inhibitor container V-587 and the corrosion inhibitor injection pump P-587 A/B (B is the reserve).

Th container V-587 is filled from the drum and the corrosion inhibitor can be sent as desired to EC-581 or to C-582.

The container V-589 which is loaded from a drum is provided with a defoamer inlet.

The defoamer is supplied to the system by circulating it along with an MDEA stream through V-589 for a short while and is drawn from the delivery side of pump P-581 A/B and then returned to the top of the column C-582 or to the pump intake P-581 A/B.

Feeding HCL and Equipment Wash:

(Ref. to process diagram B-06002 & X-06011)

The hydrochloric acid is used in the plant to replenish the chlorine loss in the catalytic system during the normal operation, or to carry out the washing of the reactors or of the flash tanks, by removing encrustations of the catalysts from the equipment wall for purpose of inspection. At the end, concentrated acid of about 30% by weight is used.

The cold acid coming from the loading bay is sent to the tank V-302 (V-402) for restoring the level. After this it can be pumped through the pump P-312 to the reactor R-301 (R 401) for washing during shut downs.

After the acid operation, the dissolved catalyst is recovered due to the pressure difference in the tank V-302 (V-402) and subsequently reloaded in the reactor during the normal operation through the pump P-302 A/B (P-402 A/B). In this manner the catalytic system is not subject to losses and therefore its recovery from the cold catalyst is not necessary.

The hydrochloric acid, coming from th bottom of the acid distillation column C-601, is r s nt to the reactor after it is mixed with a stream of concentrated acid coming from the tank V-302 (V-402) that replenish s the chlorine loss due to the formation of methyl chloride.

Gaseous Blow Down:

(Ref. to process diagram X-06009)

In this section all the collected gaseous discharges of the plant are treated before emission from BL.

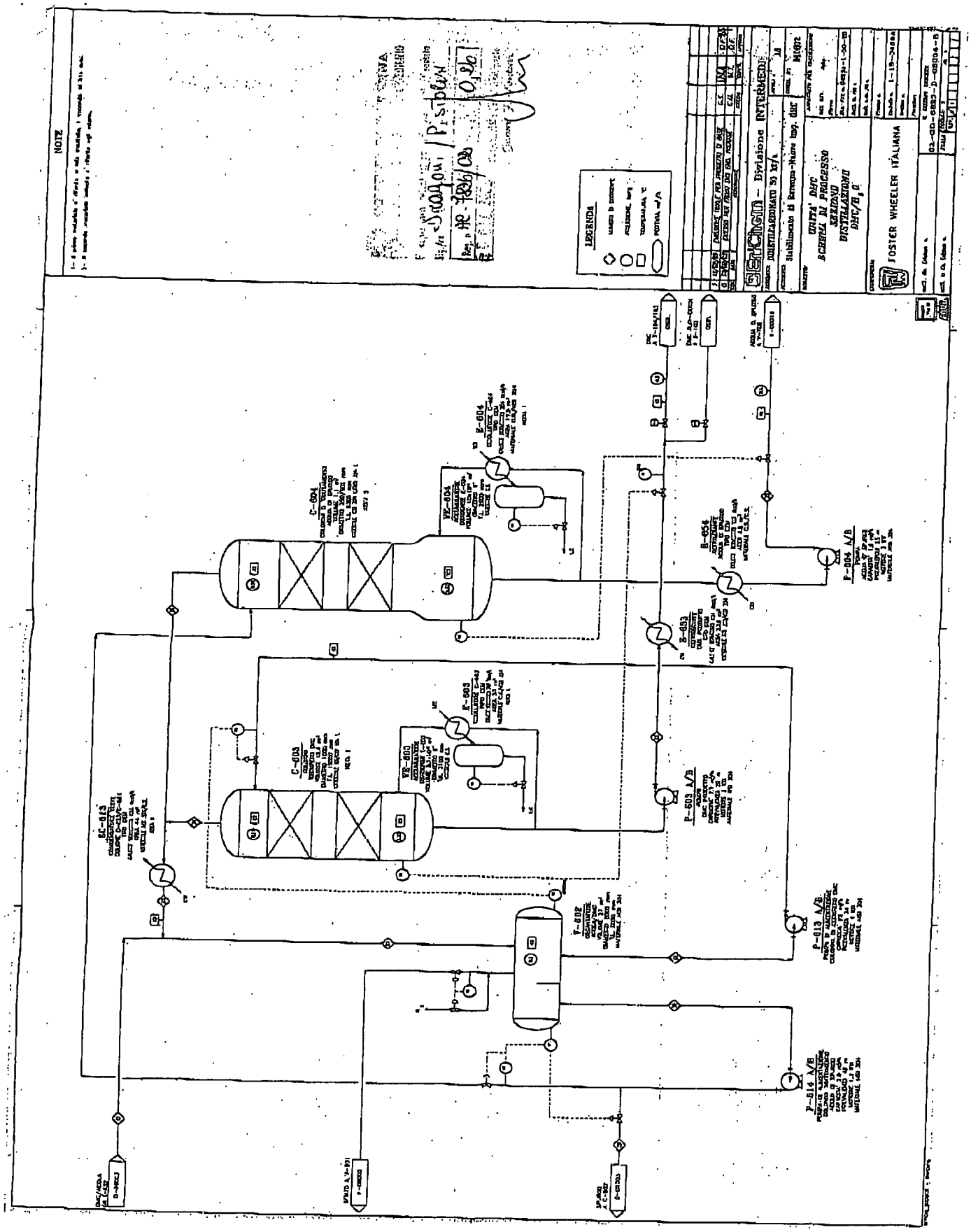
The system of collecting discharges is divided into three sections:

a) The continuous discharges consisting of a low-calorific gas are collected in a collector and sent to the separator V-801 and from there to the central thermal plant; the condensate finally collects at the bottom of V-801 and is loaded in V-703 from where it can be recycled in the process.

b) The waste gases (containing chlorine and methyl chloride) are collected in the separator V-802 and then sent to the incinerator for treatment. Any condensate in V-802 is also sent to V-703.

c) Separator trap V-803;It traps the hydrochloric acid that is present in the PSV discharge.
The separation trap V-803 has a scrubber for washing with water recirculated through the pump P-803 A/B and a water collection vessel.

In case needed, waste water is loaded in V-703 and recycled from there....

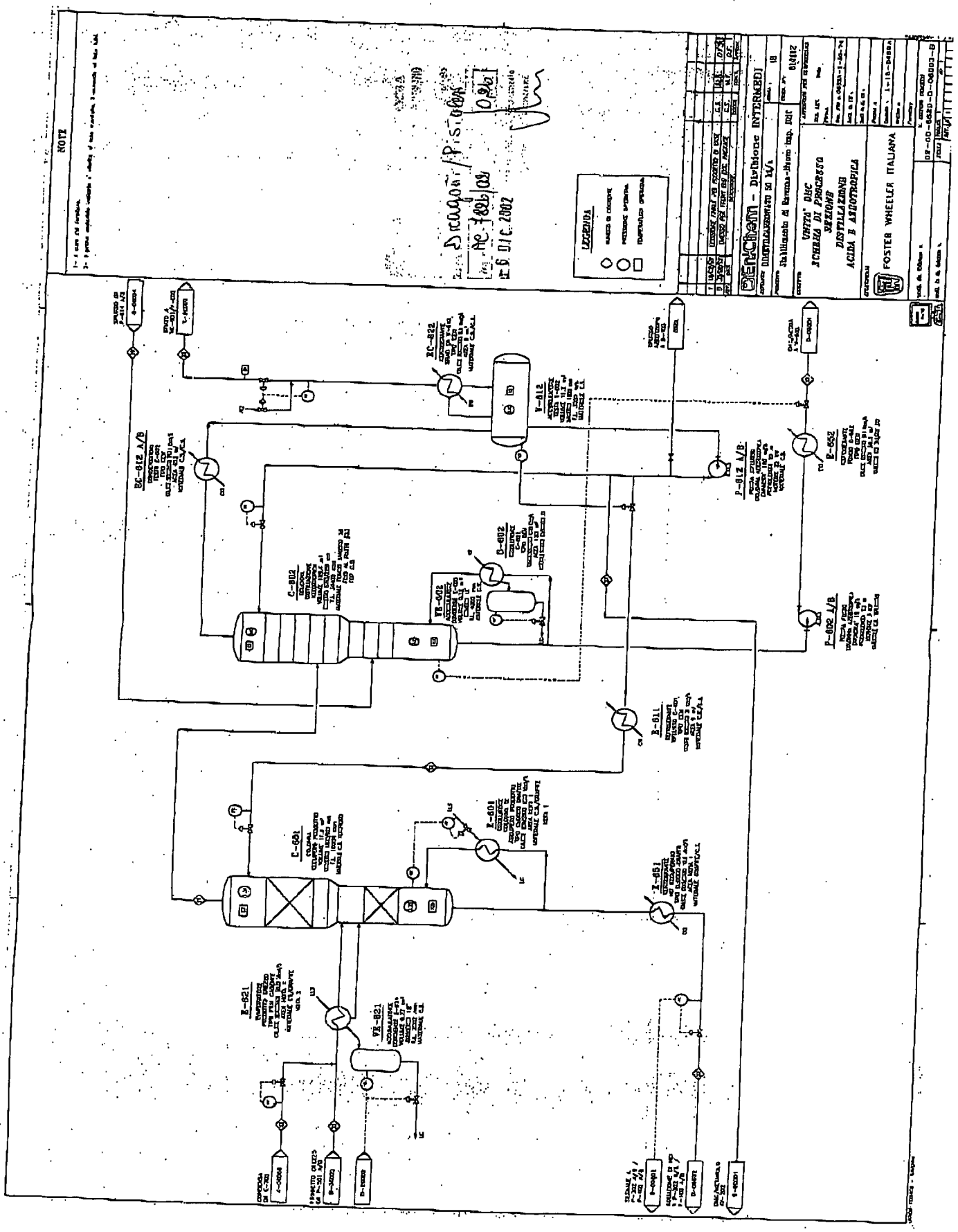


Legend	Translation
	SHEET 1
EC-613	CONDENSER TEST COLUMNS C-603/C-604 TYPE BEM HEAT TRANSFER 683 Mcal/h AREA 44 m^2 MATERIAL AISI 304/C.S. NOTE 1
C-603	COLUMNS DMC RECOVERY VOLUME 12.4 m^3 DIAMETER 1000 mm T.L. 15600 mm MATERIAL CS/AISI 304 L NOTE 2
VE-603	ACCUMULATOR CONDENSER E-603 VOLUME $5.7x10^{-2}$ m^3 DIAMETER 6" T.L. 3100 mm MATERIAL C.S.
E-603	BOILER C-603 TYPE BEM HEAT TRANSFER 767 Mcol/h AREA 57 m^2 MATERIAL C.S./AISI 304 NOTE 1
C-604	TREATMENT COLUMN CLEANING WATER VOLUME 1.1 m^3 DIAMETER 350/500 mm T.L. 8500 mm MATERIAL AISI 304 L/AISI 304 L NOTE 2
VE-604	ACCUMULATOR CONDENSER E-604

	VOLUME 4.8 x 10^{-2} m^3 DIAMETER 6" T.L. 2600 mm MATERIAL C.S.
E-604	BOILER C-604 TYPE BEM HEAT TRANSFER 204 Mcal/h AREA 11.5 m^2 MATERIAL C.S./ AISI 304 NOTE:
V-602	DECANTER WATER/DMC VOLUME 27 m^3 DIAMETER 2000 mm T.L. 8000 mm MATERIAL AISI 304
P-614 A/B	FEED PUMP TREATMENT COLUMN CLEANING WATER CAPACITY 2.6 m^3/h LIFT 40 m MOTOR 1.5 kW MATERIAL AISI 304
P-613 A/B	FEED PUMP DMC RECOVERY COLUMN CAPACITY 12 m^3/h LIFT 34 m MOTOR 4 kW MATERIAL AISI 304
P-603 A/B	PUMP DMC PRODUCT CAPACITY 7.7 m^3/h LIFT 28 m MOTOR 3 kW MATERIAL AISI 304

E-653	COOLER DMC PRODUCT TYPE BEM HEAT TRANSFER 184 Mcal/h AREA 23.6 m^2 MATERIAL AISI 304/ AISI 304
E-654	COOLER CLEANING WATER TYPE BEM HEAT TRANSFER 105 Mccl/h AREA 9.8 m^2 MATERIAL C.S./C.S.
P-604 A/B	PUMP CLEANING WATER CAPACITY 1.9 m^3/h LIFT 25 m MOTOR 3 kW MATERIAL AISI 304
IMPIANTO (PLANT)	DIMETHYL CARBONATE kt/a
PROGETTO (PROJECT)	Ravenna Works – New DMC Plant
OGGETTO (NAME)	DMC UNIT PROCESS FLOW SECTION DISTILLATION DMC/H_2O
INGEGNERIA (ENGINEERING)	FOSTER WHEELER ITALIANA
DESCRIZIONE (DESCRIPTION)	FINAL ISSUE FOR BASIC PROJECT ISSUED FOR FRONT END ENG. PACKAGE
LEGENDA(LEGEND)	PROCESS FLOW NUMBER

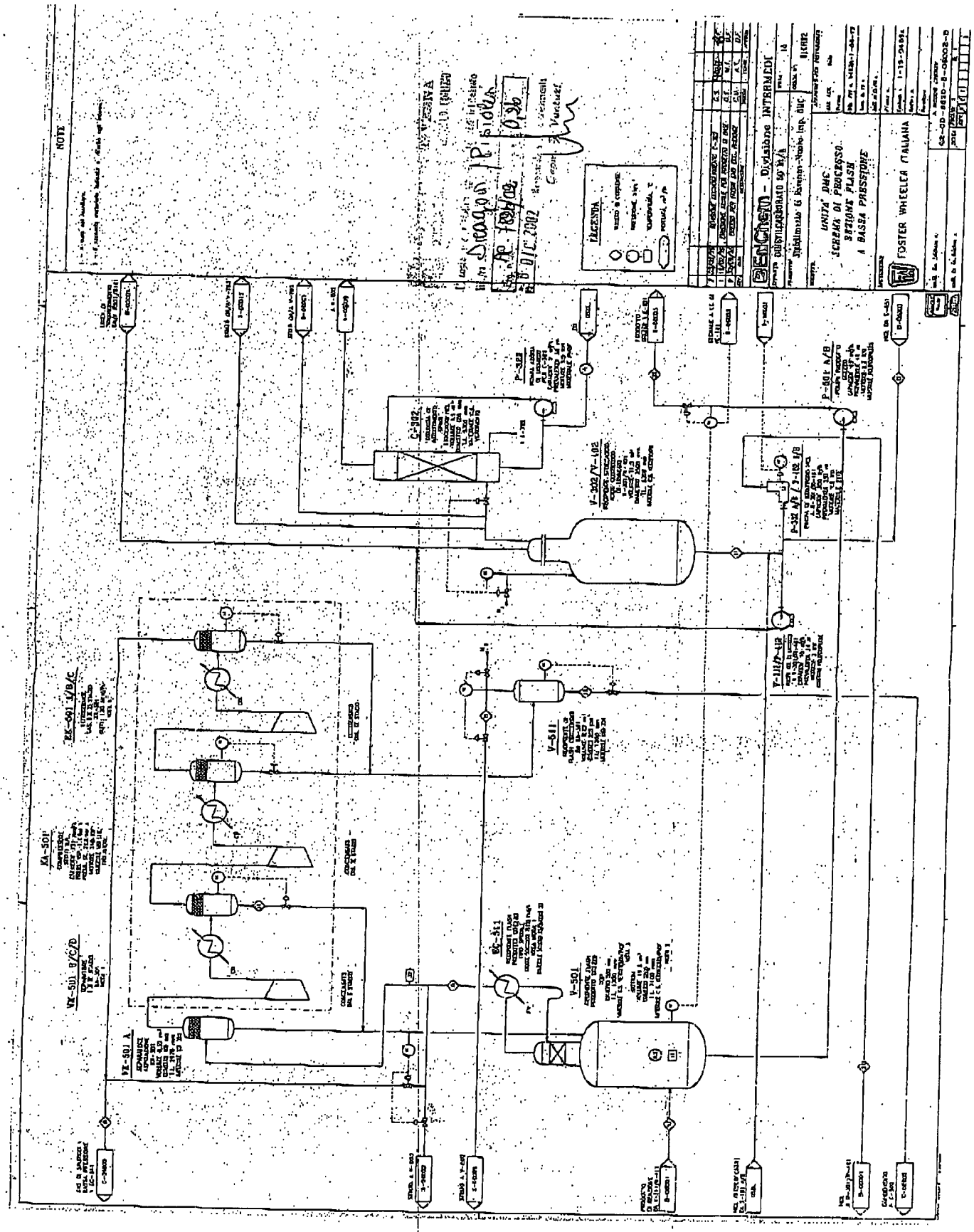
	PRESSURE, barg TEMPERATURE, ^{0}C FLOW, m^3/h
NOTE (NOTES)	1- The first material refers to the shell end, the second one to the tubes end 2- The second material indicated refers to the interiors



Legend	Translation
	SHEET 2
P-614 A/B	PURGED FROM
EC-612 A/B	CONDENSERS HEAD TYPE HEAT TRANSFER AREA MATERIAL
X-06009	VENT TO
X-06008	CONDENSED FROM
E-621	EVAPORATOR CRUDE PRODUCT FILM HEAD TYPE HEAT TRANSFER AREA NOTE 1 MATERIAL CS/GRAPHITE NOTE 2
C-601	COLUMN PRODUCT RECOVERY VOLUME DIAMETER..... MATERIAL C.S. VITRIFIED
C-602	COLUMN AZEOTROPIC DISTILLATION VOLUME DIAMETER..... MATERIAL UP TO THE PLATE
	CRUDE PRODUCT FROM
VE-602	ACCUMULATOR CONDENSER VOLUME DIAMETER MATERIAL
VE-621	ACCUMULATOR CONDENSER VOLUME DIAMETER..... MATERIAL
EC-622	COOLER VENT FROM TYPE HEAT TRANSFER AREA MATERIAL

E-601	BOILER PRODUCT RECOVERY COLUMN GRAPHITE BLOCK TYPE HEAT TRANSFER AREA NOTE 1 MATERIAL C.S./GRAPHITE NOT
E-602	BOILER.... TYPE HEAT TRANSFER AREA MATERIAL
V-612	ACCUMULATOR HEAD VOLUME DIAMETER.... MATERIAL
B-06002	SIGNAL TO
B-06002	HCL SOLUTION TO P-302...
B-06001	DMC/METHANOL
E-651	COOLER HCL RECOVERED GRAPHITE BLOCK TYPE HEAT TRANSFER AREA MATERIAL: GRAPHITE/C.S.
E-611	COOLER REFLUX TYPE HEAT TRANSFER AREA MATERIAL
P-612 A/B	REFLUX PUMP AZEOTROPIC COLUMN CAPACITY LIFT MOTOR MATERIAL
P-602 A/B	BOTTOM PUMP AZEOTROPIC COLUMN CAPACITY LIFT MOTOR MATERIAL C.S. TEFLON-COATED

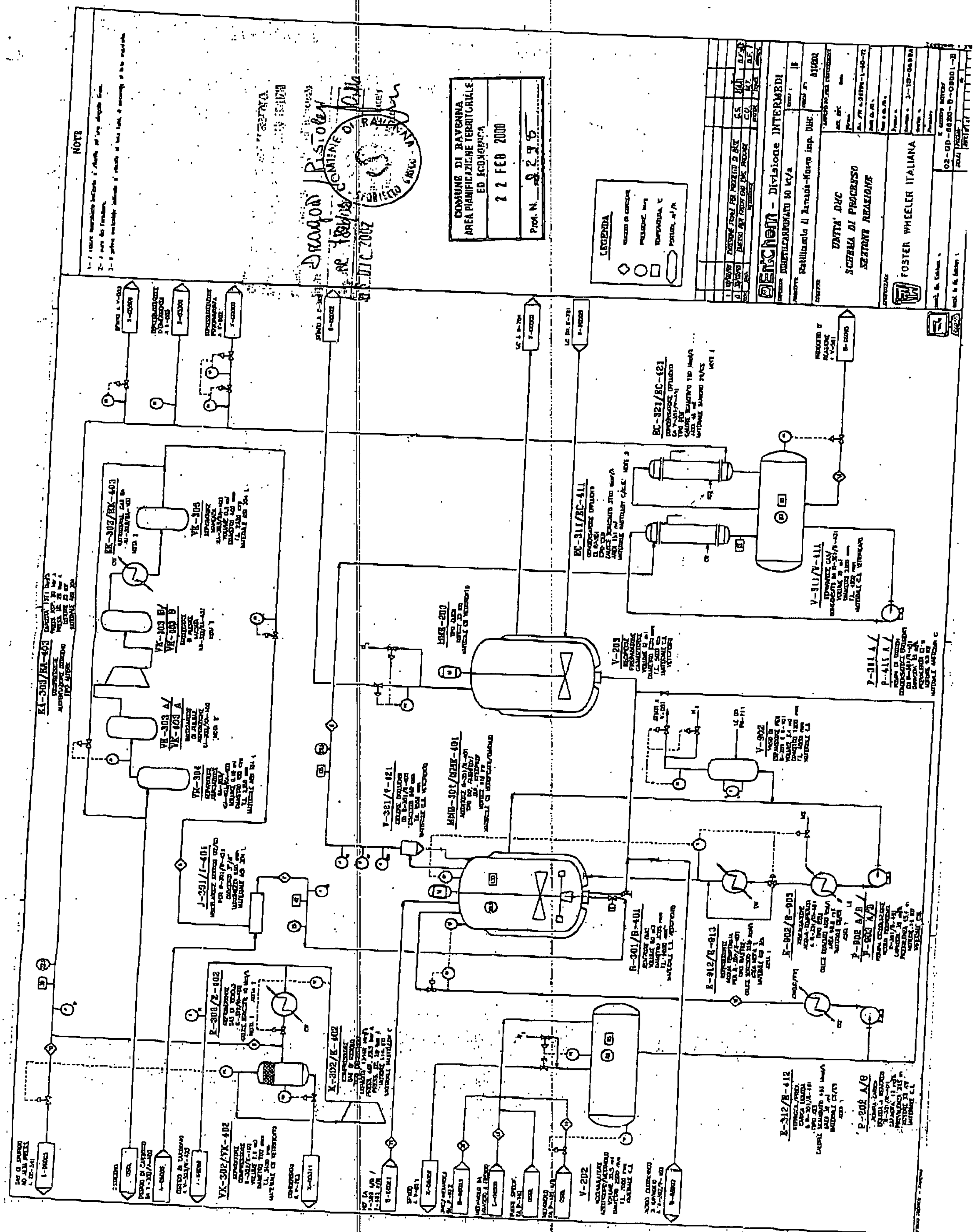
E-652	COOLER BOTTOM TYPE HEAT TRANSFER AREA MATERIAL
D-06004	DMC/WATER
NOTE (NOTES)	1- By supplier 2- The first material indicated refers to the shell end, the second one to the tubes end.
LEGENDA (LEGEND)	PROCESS FLOW NUMBER OPERATING PRESSURE OPERATING TEMPERATURE
DESCRIZIONE (DESCRIPTION)	FINAL ISSUE FOR BASIC PROJECT ISSUED FOR FRONT END ENG. PACKAGE
OGGETTO (NAME)	DMC UNIT ..... PROCESS FLOW SECTION ACID AND AZEOTROPIC DISTILLATION



Legend	Translation
	SHEET 3
C-06005	GAS PURGING: AT LOW PRESSURE
VK-501 B/C/D	SEPARATOR I II III STAGE
KA-501	COMPRESSOR VENTED L.P. CAPACITY ... MOTOR MATERIAL TYPE
EK-501 A/B/C	COOLER GAS I II III STAGE..... NOTE 1 DUTY
VK-501 A	SEPARATOR SUCTION..... DIAMETER .... MATERIAL
B-06001	TRANSFER LINE
X-06011	VENT FROM/TO
B-06001	VENTS FROM/TO
X-06009	TO ...
10	CONDENSED FROM THE I STAGE
11	CONDENSED FROM THE II STAGE
12	CONDENSED FROM THE III STAGE
X-06009	VENT TO V-803
X-06009	VENT TO V-802
EC-511	FLASH CONTAINER CRUDE PRODUCT TYPE: SPIRAL

	HEAT TRANSFER AREA NOTE 1 MATERIAL ....
C-302	BLOWING-DOWN COLUMN VENTS HCL STORAGE VOLUME DIAMETER.... MATERIAL VITRIFIED
V-511	CONDENSED FLASH CONTAINER FROM KA-501 VOLUME DIAMETER... MATERIAL
P-322	WATER SCAVENGING PUMP FOR C-302 CAPACITY LIFT MOTOR MATERIAL
V-501	FLASH CONTAINER CRUDE PRODUCT TOP DIAMETER..... MATERIAL C.S. VITRIFIED/PVDF NOTE 2 ..... DIAMETER..... MATERIAL C.S. VITRIFIED/PVDF NOTE 2
V-302/V-402	STORAGE CONTAINER HYDROCHLORIC ACID FOR SCAVENGING.... VOLUME DIAMETER ..... MATERIAL
B-05001	REACTION PRODUCT
OSBL	FRESH HCL
B-06001	HCL
C-06005	CONDENSED
P-312/P-412	HCL SCAVENGING PUMP CAPACITY LIFT MOTOR MATERIAL: POLYPROPYLENE

P-302 A/B / P-402 A/B	HCL RECOVERY PUMP CAPACITY LIFT MOTOR MATERIAL
P-501 A/B	CRUDE PRODUCT PUMP CAPACITY LIFT MOTOR MATERIAL: POLYPROPYLENE
D-06003	CRUDE PRODUCT
D-06003	SIGNAL TO...
NOTE (NOTES)	1- By the supplier 2- The second material indicated refers to the interiors.
LEGENDA (LEGEND)	PROCESS FLOW NUMBER PRESSURE, bar g TEMPERATURE FLOW
OGGETTO (NAME)	DMC UNIT PROCESS FLOW FLASH SECTION AT LOW PRESSURE


NOTE
COMUNE DI RAVENNA
AREA PIANIFICAZIONE TERRITORIALE
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LEGENDA
EniChem - Divisione INTERMEDI
UNITA' DMC
SCHEMA DI PROCESSO
SEZIONE REAZIONE
FOSTER WHEELER ITALIANA
V-202
V-203
V-902
R-301/R-401

Legend	Translation
	SHEET 4
C-06005	PURGE GAS AT HIGH PRESSURE
OSBL	OXYGEN
A-06006	CARBON MONOXIDE
A-06006	CARBON MONOXIDE
VK-302/VK-402	SEPARATOR COMPRESSOR.... VOLUMEDIAMETER.... MATERIAL CS VITRIFIED
X-06011	CONDENSED TO
B-06002	HCL FROM
X-06009	VENT(ED) TO
B-06003	DMC/METHANOL
C-06005	METHANOL FROM COLD WASHING
OSBL	OUTSIDE SPEC. FROM P-103
OSBL	METHANOL FROM P-102...
V-202	ACCUMULATOR AZEOTROPE/METHANOL VOLUME DIAMETER.... MATERIAL
B-06002	SCAVENGING HYDROCHLORIC ACID
E-302/E-402	COOLER RECYCLING GAS... HEAT TRANSFER NOTE 1 NOTE 2
K-302/K-402	COMPRESSOR RECYCLING GAS

	CENTRIFUGE TYPE CAPACITY.... MOTOR MATERIAL
J-301/J-401	STATIC MIXER FOR DIAMETER LENGTH MATERIAL
V-321/V-421	EFFLUENT CYCLONE FROM DIAMETER..... MATERIAL C.S. VITRIFIED
MME-301/MME-401	AGITATOR TYPE..... MOTOR MATERIAL CS VITRIFIED/TANTALUM
R-301/R-401	DMC REACTOR VOLUME DIAMETER... MATERIAL C.S. VITRIFIED
E-912/E-913	COOLER HARD(ENED) WATERFOR TYPE PLATES HEAT TRANSFER AREA NOTE 2 MATERIAL NOTE 1
E-312/E-412	COOLER/PREP. LIQUID CHARGE TO... TYPE HEAT TRANSFER AREA MATERIAL NOTE 1
P-202 A/B	CHARGING/SUPPLY PUMP

	LIQUID * REACTORS... CAPACITY LIFT MOTOR MATERIAL
E-902/E-903	HEATER HARD(ENED) WATERTO... TYPE HEAT TRANSFER AREA MATERIAL NOTE 1
P-902 A/B / P-903 A/B	CIRCULATION PUMP HARD(ENED) WATER.... CAPACITY LIFT MOTOR MATERIAL
VK-304	SEPARATOR SUCTION... VOLUMEDIAMETER..... MATERIAL
VK-303 A / VK-403 A	SURGE SUPPRESSOR SUCTION.... NOTE 2
KA-303/KA-403	COMPRESSOR OXYGEN SUPPLY RECIPROCATING TYPE CAPACITY..... MOTOR MATERIAL
VK-303 B / VK-403 B	SURGE SUPPRESSOR DELIVERY..... NOTE 2
EK-303/EK-403	GAS COOLER FROM..... NOTE 2
VK-305	SEPARATOR DELIVERY..... VOLUME

	DIAMETER..... MATERIAL
MME-203	IMPELLER TYPE MOTOR MATERIAL CS VITRIFIED
V-203	CONTAINER PREPARATION CATALYST VOLUME DIAMETER..... MATERIAL VITRIFIED
V-902	EXPANSION VESSEL FOR.... VOLUME DIAMETER..... MATERIAL
P-311 A / P-411 A	QUENCH PUMP EFFLUENTS CONDENSER FROM CAPACITY LIFT MOTOR MATERIAL
V-311 / V-411	SEPARATOR GAS / CONDENSED FROM... VOLUME DIAMETER..... MATERIAL C.S. VITRIFIED
V-321 / V-421	EFFLUENTS CONDENSER FROM... TYPE HEAT TRANSFER AREA MATERIAL NOTE 3
EC-321 / EC-421	EFFLUENTS CONDENSER FROM... TYPE HEAT TRANSFER AREA MATERIAL

	NOTE 3
B-06002	VENT TO
X-06009	EMERGENCY DEPRESSURISATION TO...
X-06009	PROGRAMMED/CONTROLLED DEPRESSURISATION TO...
X-06009	VENT TO
X-06008	LC TO..
X-06008	LC FROM.....
B-06002	REACTION PRODUCT
NOTES (NOTE)	1- The heat transfer indicated refers to a single line. 2- By supplier. 3- The first material indicated refers to the tubes end, the second one to the shell end.
PROGETTO (PROJECT)	RAVENNA WORKS LAND PLANNING AND REVENUE DEPARTMENT REGD. NO.
LEGENDA (LEGEND)	PROCESS FLOW NUMBER PRESSURE TEMPERATURE FLOW
DESCRIZIONE (DESCRIPTION)	FINAL ISSUE FOR BASIC PROJECT ISSUED FOR FRONT END ENG. PACKAGE
OGGETTO (NAME)	DMC UNIT PROCESS FLOW REACTION SECTION